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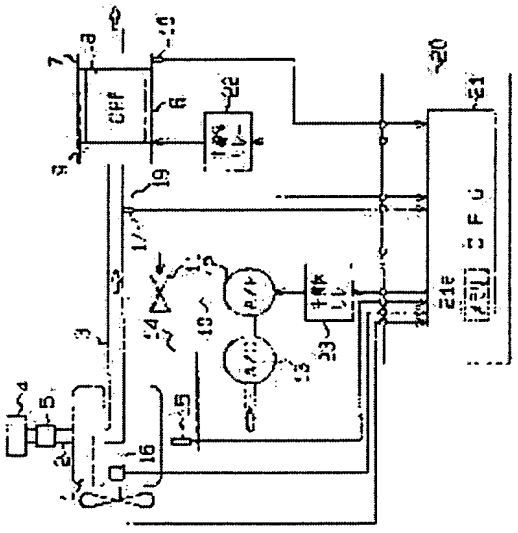
(54) EXHAUST GAS PURIFYING DEVICE FOR DIESEL ENGINE

(57)Abstract:
PURPOSE: To calculate correctly a pressure difference between pressure on upstream side and downstream side of a filter under its reference operating condition.
CONSTITUTION: A filter 8 for collecting particulates is provided in the exhaust system of a diesel engine 1. A pressure difference under the state of reference operation is found out by a CPU 21 on the basis of an intake air flow to a diesel engine 1 shown by a hot-wire type flow sensor 5 and the flow at the time of reference operation in reference to a pressure difference between pressure on the upstream side and downstream side from the filter 8 known by pressure sensors 17, 18. In the CPU 21, the fuel injection amount of the diesel engine 1 is then found out from an acceleration opening degree and engine rotational speed by using a governor pattern, and the pressure difference in reference operating condition is corrected on the basis of the fuel injection amount. In the CPU 21, when a particulate collecting amount according to the pressure difference in the reference operating condition increases to a prescribed amount or more, an electric heater 9 and an electrically driven type air pump 12 are driven so as to regenerate the filter 8.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The filter which is prepared in the exhaust air system of a diesel power plant, and carries out the uptake of the particulate. The reproduction means for burning the particulate by which the uptake was carried out to the aforementioned filter, and reproducing this filter. The pressure sensor which detects the pressure differential of the upstream in the aforementioned filter, and a downstream. The intake-air-flow sensor which is formed in the inhalation-of-air system of the aforementioned diesel power plant, and detects the intake air flow to a diesel power plant. The control circuit which will reproduce a filter with the aforementioned reproduction means if it asks for the pressure differential in criteria operational status and the amount of particulate uptakes according to the pressure differential becomes beyond a predetermined value from the intake air flow to the diesel power plant by the aforementioned intake-air-flow sensor, and the flow rate at the time of criteria operation to the pressure differential of the upstream in the aforementioned filter, and a downstream by the aforementioned pressure sensor. It is the exhaust emission control device of the diesel power plant equipped with the above, and is characterized by amending the pressure differential in the criteria operational status in the aforementioned control circuit based on the fuel oil consumption of the aforementioned diesel power plant.
[Claim 2] The fuel oil consumption of the aforementioned diesel power plant is the exhaust emission control device of the diesel power plant according to claim 1 which is that for which memorizes beforehand the centrifugal-spark-advancer pattern which is the injection property of a fuel injection pump, detects accelerator opening and an engine speed, and it asks from accelerator opening and an engine speed using a centrifugal-spark-advancer pattern.
[Claim 3] The fuel oil consumption of the aforementioned diesel power plant is the exhaust emission control device of the diesel power plant according to claim 1 which is that for which it asks by incorporating the injection-quantity signal from an engine control computer.
[Claim 4] The fuel oil consumption of the aforementioned diesel power plant is the exhaust emission control device of the diesel power plant according to claim 1 which is that for which it asks directly by the spill position sensor or the control rack position sensor.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the exhaust emission control device of a diesel power plant.
[0002]
[Description of the Prior Art] The DPF (diesel particulate filter) system is adopted as a cure against a black smoke of a diesel power plant. This incinerates the particulate by which formed DPF32 which carries out the uptake of the particulate to the exhaust air system of a diesel power plant 31, supplied the secondary air to DPF32 by driving an air pump 35 while lighting the particulate by which the uptake was carried out to DPF32 by energizing an electric heater 34 by CPU33 at the time of filter reproduction, and the uptake was carried out to DPF32 as shown in drawing 3 . In order to judge whether it reproduces or not at this time, CPU33 calculates the pressure differential in criteria operational status from the pressure differential of the upstream in DPF32, and a downstream by pressure sensors 36 and 37 from the inhalation-of-air air flow rate to the diesel power plant by the intake-air-flow sensor 38, and the flow rate at the time of criteria operation.
[0003] That is, since DPF32 has a laminar-flow property, the differential pressure which is proportional to the ventilation resistance by DPF32 to a volumetric flow rate generates it. However, ventilation resistance is decided by initial pressure loss of DPF32, and the amount of particulate uptakes. Suppose that the differential pressure before and behind DPF32 generated when a volumetric flow rate V flowed into DPF32 under a certain amount of uptakes was deltaP. At this time, the detection value by the intake-air-flow sensor 38 was used as a volumetric flow rate V. moreover, criteria volumetric flow rate Vstd when being based on a certain operational status it is -- the time -- pressure differential deltaP1 in criteria operational status It is computed by (1) formula.
[0004]
deltaP1 =deltaP- (Vstd/V) ... (1)
And pressure differential deltaP1 in the criteria operational status It will reproduce, if the amount of particulate uptakes to which it responded becomes beyond a predetermined value.
[0005]
[Problem(s) to be Solved by the Invention] However, since the volumetric flow rate V of the exhaust air which flows into DPF32 is calculated only based on the intake air flow which flows into a diesel power plant 31 and the intake air flow by the intake-air-flow sensor 38 and the volumetric flow rate of the exhaust air which flows into DPF32 are not in agreement, an error will occur in the pressure differential in criteria operational status.
[0006] Then, the purpose of this invention is to offer the exhaust emission control device of the diesel power plant which can compute correctly the pressure differential of the upstream of the filter in criteria operational status, and a downstream.

[0007]
[Means for Solving the Problem] The filter which this invention is prepared in the exhaust air system of a diesel power plant, and carries out the uptake of the particulate, The reproduction means for burning the particulate by which the uptake was carried out to the aforementioned filter, and reproducing this filter, The pressure sensor which detects the pressure differential of the upstream in the aforementioned filter, and a downstream, The intake-air-flow sensor which is formed in the inhalation-of-air system of the aforementioned diesel power plant, and detects the intake air flow to a diesel power plant, The pressure differential in criteria operational status is calculated from the pressure differential of the upstream in the aforementioned filter, and a downstream by the aforementioned pressure sensor from the intake air flow to the diesel power plant by the aforementioned intake-air-flow sensor, and the flow rate at the time of criteria operation. In the exhaust emission control device of the diesel power plant equipped with the control circuit which reproduces a filter with the aforementioned reproduction means when the amount of particulate uptakes according to the pressure differential became beyond a predetermined value Let the exhaust emission control device of the diesel power plant which amended the pressure differential in the criteria operational status in the aforementioned control circuit based on the fuel oil consumption of the aforementioned diesel power plant be the summary.
[0008] The fuel oil consumption of a diesel power plant memorizes beforehand the centrifugal-spark-advancer pattern which is the injection property of a fuel injection pump, and it detects accelerator opening and an engine speed and you may make it ask for them from accelerator opening and an engine speed here using a centrifugal-spark-advancer pattern.
[0009] Moreover, you may make it calculate the fuel oil consumption of a diesel power plant by incorporating the injection-quantity signal from an engine control computer. Furthermore, you may make it calculate the fuel oil consumption of a diesel power plant directly by the spill position sensor or the control rack position sensor.
[0010]
[Function] A control circuit calculates the pressure differential in criteria operational status from the pressure differential of the upstream in a filter, and a downstream by the pressure sensor from the intake air flow to the diesel power plant by the intake-air-flow sensor, and the flow rate at the time of criteria operation. At this time, the pressure differential in criteria operational status is amended based on the fuel oil consumption of a diesel power plant. That is, according to fuel oil consumption, the variation of the amount of pumping accompanying combustion of the fuel in a diesel power plant is calculated, and it is reflected in calculation of the pressure differential in criteria operational status. And a control circuit will reproduce a filter with a reproduction means, if the amount of particulate uptakes according to the pressure differential becomes beyond a predetermined value.
[0011]
[Example] Hereafter, one example which materialized this invention is explained according to a drawing. The whole exhaust-emission-control-device block diagram of a diesel power plant is shown in drawing 1 .
[0012] The diesel power plant 1 is carried in vehicles. The inlet pipe 2 and the exhaust pipe 3 are connected to the diesel power plant 1. The air cleaner 4 for engines is formed in the best style section of an inlet pipe 2. Moreover, in the middle of an inlet pipe 2, the heat ray formula flow rate sensor 5 is formed, and this sensor 5 detects an intake air flow (volumetric flow rate).
[0013] The housing 7 of an exhaust emission control device 6 is formed in the exhaust pipe 3 of a diesel power plant 1. Housing 7 is open for free passage with the exhaust pipe 3, and the exhaust gas of a diesel power plant 1 passes through the inside of housing 7. In housing 7, the filter (DPF) 8 which consists of ceramic porosity is formed, and the uptake of the particulate discharged from a diesel power plant 1 with a filter 8 is carried out. Furthermore, an electric heater 9 is formed in the upstream edge of a filter 8, and the particulate by which this electric heater 9 generated heat by

energization of an electric heater 9, and the uptake was carried out with the filter 8 is lit.
[0014] The secondary air supply pipe 10 branches, and while being the secondary air supply pipe 10, the electro-magnetic valve 11 is arranged at the upstream of the housing 7 in an exhaust pipe 3. This electro-magnetic valve 11 is for making it exhaust gas not usually flow backwards for a secondary air supply path at the time of operation. The discharge side of the electromotive air pump 12 is connected at the nose of cam of the secondary air supply pipe 10. Moreover, the air cleaner 13 for air pumps is formed in the inspired air flow path of the electromotive air pump 12. And in the valve-opening state of an electro-magnetic valve 11, the secondary air is supplied to the inlet pipe 3 of a diesel power plant 1 by the drive of the electromotive air pump 12.
[0015] Moreover, the centrifugal spark advancer 14 for fuel injection pumps is attached in the diesel power plant 1, and the accelerator opening sensor 15 is formed in the centrifugal spark advancer 14. Furthermore, the rotational frequency sensor 16 is formed in a diesel power plant 1, and this sensor 16 detects an engine speed.
[0016] A pressure sensor 17 is formed in the upstream of a filter 8, and this sensor 17 detects the absolute pressure (total pressure) of the upstream of a filter 8. A pressure sensor 18 is formed in the downstream of a filter 8, and this sensor 18 detects the absolute pressure (back **) of the downstream of a filter 8. A temperature sensor 19 is formed in an exhaust pipe 3, and this sensor 19 detects the exhaust air absolute temperature (close gas **) which flows into a filter 8.
[0017] The electronic control unit (ECU) 20 is equipped with CPU21. And CPU21 is connected with an electric heater 9 through the semiconductor relay 22, and energization of an electric heater 9 is controlled according to the control signal from CPU21. Moreover, CPU21 is connected with the electromotive air pump 12 through the semiconductor relay 23, and the drive of the electromotive air pump 12 is controlled according to the control signal from CPU21.
[0018] Moreover, the heat ray formula flow rate sensor 5, the accelerator opening sensor 15, the rotational frequency sensor 16, a pressure sensor 17, a pressure sensor 18, and a temperature sensor 19 are connected to CPU21, and the output signal from these sensors is incorporated by CPU21.
[0019] Moreover, memory 21a is prepared in CPU21, and the centrifugal-spark-advancer pattern which is the injection property of a fuel injection pump is beforehand memorized by this memory 21a. And fuel oil consumption can be detected now from accelerator opening and an engine speed using this centrifugal-spark-advancer pattern.
[0020] Next, the calculation method of the pressure differential of the filter 8 in the criteria operational status which considered fuel oil consumption is explained. First, the influence to the volumetric flow rate of exhaust air of fuel oil consumption is explained.
[0021] The about 80% of the inhaled air is nitrogen (N2), and about 20 remaining% is oxygen (O2). Therefore, the molecular formula of the inhaled air is expressed with the following chemical formula.
A (8N2+2O2) ... (2)
However, A is a constant and is determined with an inhalation volumetric flow rate.
[0022] Moreover, the molecular formula of the gas oil which is fuel is expressed with the following chemical formula.
B (Cx Hy Oz) ... (3)
However, B is a constant and is determined with fuel oil consumption.
[0023] The volumetric flow rate of exhaust gas is obtained by the chemical reaction of the chemical formula of (2) formulas, and the chemical formula of (3) formulas. Moreover, the components generated by the chemical reaction are NO2, NO, CO2, CO, H2 O, etc. However, a reaction formula is as follows, when only oxygen and fuel are taken into consideration, in order to give explanation simple.
[0024]
[Equation 1]

$$a(O_2)+b(C_xH_yO_z)\rightarrow bX(CO_2)+\frac{by}{2}(H_2O)$$
気体　液体　気体　気体

$$+\left(a+\frac{bz}{2}-bx-\frac{by}{4}\right)O_2$$
気体

••• (4)

[0025] However, they are a=2andA, and b=B. a, bx, y, and z are constants. a is determined with an inhalation volumetric flow rate. b is determined with fuel oil consumption. x, and y and z are determined of a fuel component.
[0026] (4) The molecularity of exhaust gas changes from a formula only a part to have expressed to (5) formulas from the molecularity of inhalation-of-air gas.
n1 =(b/4) - (y+2z) ... (5)
Variation deltaV of the volumetric flow rate produced by fuel injection becomes like (6) formulas.
[0027]
deltaV=n1 radiographic/P ... (6)
However, T is [a gas constant and P of gas ** and R] the pressures of the upstream of a filter 8.
[0028] Therefore, the calculation formula of the pressure differential of the filter 8 in the criteria operational status which considered fuel oil consumption becomes like (7) formulas.
deltaP1 =deltaP-Vstd/(V+deltaV) ... (7)
However, it is the volumetric flow rate and Vstd which flow into the filter 8 which asked for deltaP from the pressure differential of the upstream of a filter 8, and a downstream, and asked for V from the inhalation air content. It is a criteria volumetric flow rate under the service condition of criteria.
[0029] In addition, a reproduction means consists of an electric heater 9 and an electromotive air pump 12, an intake-air-flow sensor consists of heat ray formula flow rate sensors 5, and the control circuit is constituted from this example by CPU21.
[0030] Next, an operation of the exhaust emission control device of the diesel power plant constituted in this way is explained. Operation in CPU21 under reproduction is explained according to the flow chart of drawing 2 .
[0031] First, a diesel power plant 1 sets on stream, and CPU21 incorporates the heat ray formula flow rate sensor 5, the accelerator opening sensor 15, the rotational frequency sensor 16, a pressure sensor 17, a pressure sensor 18, and each sensor signal of a temperature sensor 19 at Step 100. And CPU21 detects an intake air flow, accelerator opening, an engine speed, the upstream pressure (total pressure) of a filter 8 and a downstream pressure (back **), and close gas ** with the signal from this sensor. Then, CPU21 judges whether reproduction conditions were satisfied at Step 101.
[0032] That is, CPU21 calculates the volumetric flow rate V which flows into the filter 8 for which it asked from the inhalation air content by the total pressure by the intake air flow (volumetric flow rate) by the heat ray formula flow rate sensor 5, close gas ** by the temperature sensor 19, and the pressure sensor 17. Moreover, CPU21 asks for pressure-differential deltaP of the upstream of a filter 8, and a downstream by deducting back ** from a total pressure. Furthermore, CPU21 calculates fuel oil consumption by accelerator opening and the engine speed using the centrifugal-spark-advancer pattern of memory 21a. And CPU21 is the criteria volumetric flow rate Vstd under the service condition of criteria. Pressure differential deltaP1 of the filter 8 in (7) formulas of the above-mentioned [value] to criteria operational status It asks. Namely, while calculating b value from fuel oil consumption in (5) formulas, y value and z value are calculated from a fuel component. These are substituted for (5) formulas and it is the variation n1 of molecularity. It asks and is this n1. Substitute a value and the upstream pressure P of gas ** T and a filter 8 for (6) formulas, and it

asks for variation deltaV of a volumetric flow rate. This deltaV value, pressure-differential deltaP of the upstream and the lower stream of a river of a filter 8, and criteria volumetric flow rate Vstd The volumetric flow rate V which flows into the filter 8 for which it asked from the inhalation air content is substituted for (7) formulas, and it is the pressure differential deltaP1 of the filter 8 in criteria operational status. It asks. In addition, criteria volumetric flow rate Vstd It asks beforehand and is a volumetric flow rate in a certain criteria operational status.

[0033] And CPU21 is the pressure differential deltaP1 in criteria operational status. This routine is ended, when the amount of particulate uptakes to which it responded is under a predetermined value and is judged that reproduction is not required. On the other hand, CPU21 is the pressure differential deltaP1 in criteria operational status. The amount of particulate uptakes to which it responded becomes beyond a predetermined value, and reproduction is started when reproduction is required.

[0034] If, as for CPU21, reproduction is started at the time of the shutdown of a diesel power plant 1, an electro-magnetic valve 11 will be opened at Step 102, and it will enable it to supply air (oxygen) from the electromotive air pump 12. Furthermore, CPU21 determines the reproduction conditions when performing reproduction control of an exhaust emission control device 6 at Step 103. Here, the target control power of the target control flow rate of the electromotive air pump 12 or an electric heater 9 is determined.

[0035] Next, CPU21 performs drive control of the electromotive air pump 12 while performing energization control of an electric heater 9 at Step 104. That is, the particulate by which the uptake was carried out to the filter 8 by energization of an electric heater 9 is lit, the secondary air is supplied by the drive of the electromotive air pump 12, a particulate is incinerated, and reproduction of a filter 8 is performed.

[0036] And CPU21 judges elapsed time after a reproduction start at Step 105, and when it passes rather than the setup time, it ends reproduction. thus, in this example the intake air flow to a diesel power plant 1 and the criteria volumetric flow rate Vstd by pressure sensors 17 and 18 according to pressure-differential deltaP of the upstream in a filter 8, and a downstream to the heat ray formula flow rate sensor 5 (inhalation-of-air air flow rate sensor) from -- pressure differential deltaP1 in criteria operational status In case it asks it asks for variation deltaV of the volumetric flow rate produced by the fuel injection of (6) formulas based on the fuel oil consumption of a diesel power plant 1, and is shown in (7) formulas using this variation deltaV -- as -- deltaP1 an amendment -- it was made like That is, it asks for variation deltaV of the amount of pumping accompanying combustion of the fuel in a diesel power plant 1 according to fuel oil consumption, and is the pressure differential deltaP1 in criteria operational status. You make it reflected in calculation. Therefore, the pressure differential of the upstream of the filter 8 in criteria operational status and a downstream can be computed correctly.

[0037] In addition, this invention is not limited to the above-mentioned example, and when fuel-oil-consumption control of a diesel power plant is being performed [for example,] by electronics control as the detection method of fuel oil consumption, you may make it detect fuel oil consumption by incorporating the injection-quantity signal from an engine control computer. Moreover, as the detection method of fuel oil consumption, when a distributed type jet pump is used, you may calculate fuel oil consumption directly by the spill position sensor. Or when a sequence-type jet pump is used, you may calculate fuel oil consumption directly by the control rack position sensor.

[0038]

[Effect of the Invention] As explained in full detail above, according to this invention, the outstanding effect which can compute correctly the pressure differential of the upstream of the filter in criteria operational status and a downstream is demonstrated.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the whole exhaust-emission-control-device block diagram of the diesel power plant of an example.
[Drawing 2] It is a flow chart for explaining an operation.
[Drawing 3] It is the whole exhaust-emission-control-device block diagram of the conventional diesel power plant.
[Description of Notations]
1 Diesel Power Plant
5 Heat Ray Formula Flow Rate Sensor as an Intake-Air-Flow Sensor
8 Filter
9 Electric Heater Which Constitutes Reproduction Means
12 Electromotive Air Pump Which Constitutes Reproduction Means
18 CPU as a Control Circuit

[Translation done.]